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A Coded Wire Tag Assessment of Salmon River (Langley) Coho Salmon: 1990 Tag Application and 1991-1992 Spawner Enumeration

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A CODED WIRE TAG ASSESSMENT OF SALMON RIVER (LANGLEY) COHO SALMON: 1990 TAG APPLICATION AND 1991-1992 SPAWNER ENUMERATION

by

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ABSTRACT

Farwell, M.K., N.D. Schubert and L.W. Kalnin. 1992. A coded wire tag assessment of Salmon River (Langley) coho salmon: 1990 tag application and 1991-1992 spawner enumeration. Can. Manuscr. Rep. Fish. Aquat. Sci. 2153: 42 p.

In 1986, the Department of Fisheries and Oceans implemented a plan to improve the assessment data for coho salmon (*Oncorhynchus kisutch*) through the long term evaluation of key stocks. The Salmon River (Langley) was selected for the evaluation, with known precision, of annual escapement, marine survival, harvest distribution and exploitation rate. An estimated 20,390 (corrected for long term tag loss) coho smolts were released with coded wire tags (CWT) in spring of 1990 at an average size of 94.6 mm and 8.6 g. The adult escapement was estimated in fall and winter 1991-1992 using the Petersen mark-recapture method. Escapement was estimated at 4,321 coho adults of which an estimated 411 had coded wire tags and 37 (8.3%) had lost the coded wire tag. Survival to escapement was 2.0%.

Key Words: Coho salmon, Salmon River (Langley), key stream, coded wire tag, escapement, survival.

RÉSUMÉ

Farwell, M.K., N.D. Schubert and L.W. Kalnin. 1992. A coded wire tag assessment of Salmon River (Langley) coho salmon: 1990 tag application and 1991-1992 spawner enumeration. Can. Manuscr. Rep. Fish. Aquat. Sci. 2153: 42 p.

En 1986, le ministère des Pêches et Océans a entrepris une évaluation à long terme des stocks clés pour améliorer la base de données sur le saumon coho (*Oncorhynchus kisutch*). Il a choisi de faire cette évaluation dans la rivière Salmon (Langley) et d'établir des données précises sur l'échappée annuelle, la survie, la répartition des captures et le taux d'exploitation. Au printemps de 1990, environ 20 390 (chiffre ajusté pour tenir compte des pertes à long terme de micromarques magnétisées codées) jeunes saumons mesurant en moyenne 94,6 mm, pesant en moyenne 8,6 g, et pourvus d'une micromarque magnétisée codée ont été relâchés. L'échappée des adultes a été estimée à l'automne et au printemps de 1991-1992 au moyen de la technique Petersen de marquage-recapture. L'échappée a été estimée à 4 321 poissons, dont 411 avaient encore leur micromarque et 37 (8,3%) l'avaient perdue. La survie à l'échappée des cohos géniteurs de 1988 de la rivière Salmon était de 2,0%.

Mots clés: Saumon coho, rivière Salmon (Langley), cours d'eau important, micromarque magnétisée codée, échappée, survie.

INTRODUCTION

In 1986, the Department of Fisheries and Oceans implemented a plan to improve coho salmon (*Oncorhynchus kisutch*) assessment data through the long term evaluation of key stocks. The Salmon River was selected for the evaluation, with known precision, of annual escapement, marine survival, harvest distribution and exploitation rate.

The Salmon River was designated a key stream for three reasons. First, because recent escapements comprised 4% of the Fraser River total (Farwell *et al.* 1987), the status of Salmon River coho is an important measure of the status of the Fraser River coho resource. Second, data collected from the 1976-1978 brood years (Schubert 1982a; Schubert and Fleming 1989) provided a time series of comparable data. Third, simplified logistics limited project costs.

This report documents, for the 1988 brood, the 1990 coho smolt coded wire tag (CWT) application and 1991-1992 coho adult escapement estimation studies. Previous reports documented the evaluation of the 1984-1987 brood years (Schubert and Kalnin 1990; Farwell *et al.* 1991, 1992; Kalnin and Schubert 1991). This report describes field methods, analytic techniques and study results, including smolt timing, age and size and adult age, length, sex, adipose fin clip (AFC) incidence and estimates of escapement and long term CWT loss. The study did not estimate the escapement of precocious males (jacks). The report concludes with a discussion of data limitations and study results for the 1984-1987 brood years.

STUDY AREA

The Salmon River flows northwest for 33 km, entering the Fraser River west of Fort Langley (Fig. 1). Coghlan Creek, the principal tributary, joins the mainstem 14 km upstream from the Fraser River. The system, with an average annual discharge of 1.41 m^3/s (Environment Canada 1986), drains 85 km^2 of agricultural and residential land. During the Fraser River spring freshet, the Salmon River passes through a pumphouse located at the river mouth. Because no provisions were made for fish passage. Up to 31% of the coho smolts are killed when they pass through the pumps (Russell MS 1981).

Coho adults enter the river at ages 3_2 and 4_3 and spawn in the middle and upper reaches from November to January (Schubert 1982b; Schubert and Fleming 1989). Coho escapements averaged 3,000 and 2,400 in 1970-1979 and 1980-1986, respectively (Farwell *et al.* 1987).

METHODS

JUVENILE PROGRAM

Fish Capture

Fence traps similar to those described by Schubert (1982a) operated in the Salmon River (30 m above the Coghlan Creek confluence) from April 24 to June 4, 1990 and in Coghlan Creek (50 m above the Salmon River confluence) from April 20 to June 3, 1990.

Captured fish were enumerated at least once daily. Coho smolts were transferred to holding boxes or to the tagging site for tagging and sampling. Coho fry were not enumerated because the 6 mm fence mesh did not fully restrict their passage. The remaining catch was identified to species and released below the fence. Steelhead and cutthroat trout were recorded as smolt or presmolt. Smolts had a silver coloration and nose-fork (NF) length greater than 11 cm. Presmolts had distinct parr marks and NF length less than 11 cm.

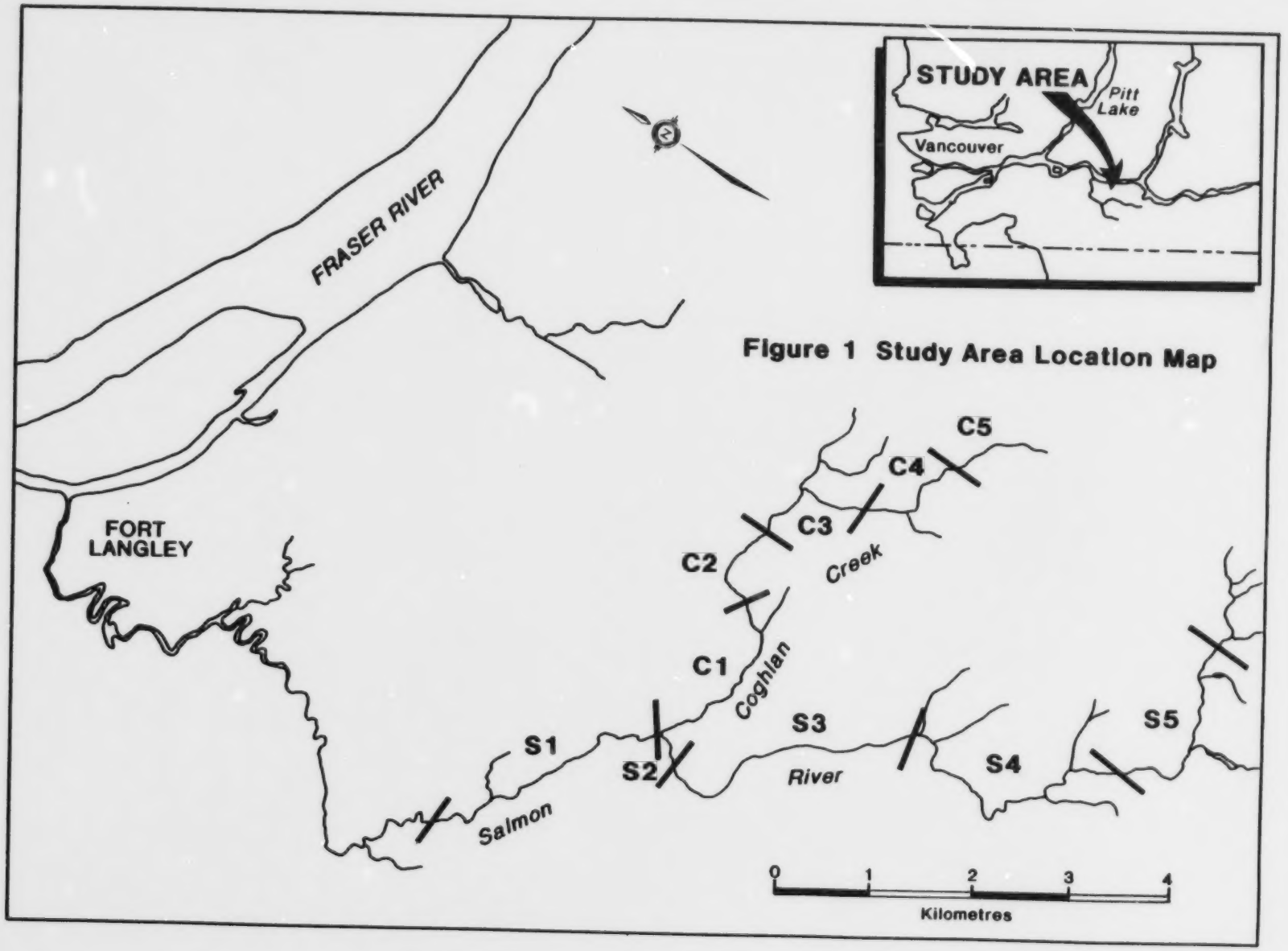

Figure 1 Study Area Location Map

Coded Wire Tagging

The CWT equipment and methods were described by Armstrong and Argue (1977). Coded wire tagging occurred from April 24 to June 4, 1990 at intervals of one to four days. On each day, smolts were sorted by size (NF length greater or less than 100 mm) and separate nose moulds and implant depths were used for each group. Implant depth was checked by bisecting the skull of a tagged smolt along the median plane. If the CWT was not in the preferred position in the cartilaginous wedge of the skull, the implant depth was adjusted and the procedure repeated until CWT placement was correct. The nose mould was then marked to permit correct placement after nose mould changes. The smolts were anaesthetized with Tricaine Methane Sulfonate (TMS), marked by adipose fin removal, coded wire tagged and passed through a quality control device to ensure the CWT was present. Any diseased, damaged or undersize (NF length less than 55 mm) smolts were released untagged. A representative sample of approximately 200 smolts was removed from the recovery bucket and retained for 24 hours for assessment of AFC quality, delayed mortality and CWT loss. Any coho without a CWT or with a poor AFC was retagged or reclipped.

Transport

To avoid pump mortality, all coho smolts were transported and released at the Salmon River mouth, either immediately after tagging or in the morning when water temperatures were lower. The smolts were transported in a 180 l plastic container supplied with air from a twelve volt air pump. Transport required less than fifteen minutes.

Sampling

Fifty coho smolts per site were sampled twice weekly for scales, length and weight. The smolts were anaesthetized with TMS, a scale smear was removed with a scalpel from each preferred region, NF length was measured to the nearest mm, and mean wet weight (±0.1g) was determined in aggregate on a triple beam balance.

ADULT PROGRAM

Fish Capture

Coho adults were captured in reaches S1 to S5 and C1 to C5 (Fig. 1) from November 6 to December 20, 1991. Coho were attracted from log jams and cut banks with an electroshocker using direct current. Voltage (600 volts) and frequency (15 to 30 milliseconds) were adjusted daily to ensure the fish were undamaged, but stunned sufficiently to permit capture. Stunned coho were captured in a dip net, permitted to recover in a 60 l container of water, disk tagged and released.

Disk Tag Application

Coho adults (NF length greater than 30 cm) were marked with Petersen disk tags in a wooden tray (10 cm x 10 cm x 100 cm) constructed with a flexible plastic bottom and a meter stick recessed in one side. The tags consisted of two 2.2 cm diameter laminated cellulose acetate disks and one 0.7 cm diameter transparent plastic buffer disk threaded through centrally punched holes onto a 7.7 cm long nickel pin. The pin was inserted with pliers through the musculature and pterygiophore bones approximately 1.2 cm below the anterior portion of the dorsal fin insertion. The disk tags, arranged with one on each side of the fish and with a buffer disk on the pin head side, were secured by twisting the pin into a double knot. One disk per pair was numbered with a unique code. Green disk tags were used to reduce colour contrast, thereby minimizing recovery and predation biases.

Each tagged fish received a secondary mark to allow the assessment of disk tag loss. One or two 0.7 cm diameter holes were punched through the right operculum of males and females, respectively, using a single hole paper punch. Care was taken to avoid gill tissue damage.

Date and location (reach) of capture, disk tag number, NF length (±0.1 cm), sex and adipose fin status were recorded for each fish released with a disk tag. Release condition was recorded as 1 (swam away vigorously), 2 (swam away sluggishly) or 3 (required ventilation). Recovered disk tagged carcasses were enumerated and sampled (described below) to assess handling mortality.

Stream Surveys

Weekly stream surveys were conducted from December 2, 1991 to January 14, 1992. Complete surveys, conducted by a two to four person crew walking in an upstream direction, required up to two days.

Live adults were counted and carcasses were recorded by date, reach, sex (confirmed by abdominal incision) and mark type (disk tag, secondary mark or AFC). Each marked carcass and every tenth unmarked carcass was sampled. Carcasses less than 30 cm NF length were recorded as jacks. All carcasses were then cut in two with a machete and returned to the river. Sample data, recorded by date and reach, included postorbital-hypural plate (POH) length (to the nearest 0.1 cm), sex, female spawning success (0%, 50% or 100% spawned), adipose fin and carcass condition, and scale samples. The head of AFC coho was removed posterior to the eye orbit for later CWT identification. Adipose fin condition was recorded as unclipped, complete (flush with dorsal surface), partial (nub present) or questionable (appeared clipped but fungus or decomposition obscured the area). The condition of AFC carcasses was recorded as fresh (gills red or mottled), moderately fresh (gills white, body firm), moderately rotten (body intact, flesh soft) or rotten (skin and bones), and the absence of one or both eyes was noted.

Escapement Estimation

Total Escapement: The 1991-1992 escapement of Salmon River coho adults was calculated from the mark-recapture data using the Petersen formula (Chapman modification) (Ricker 1975). Total escapement was the sum of escapement by sex:

1) Estimated Salmon River system coho escapement (N_t):

$$N_t = N_m + N_f$$

where:

N_m = estimated escapement of adult males;

$$= \frac{(M_m + 1)(C_m + 1)}{(R_m + 1)}$$

N_f = estimated escapement of females, analogous to above.

2) Estimated 95% confidence limits of N_t:

$$N_t \pm 1.96 \sqrt{V_t}$$

where:

N_t = total escapement estimate;

V_t = variance of the escapement estimate;

$= V_m + V_f$

V_m = variance of the adult male escapement estimate;

$$= \frac{(N_m^2)(C_m - R_m)}{(C_m + 1)(R_m + 2)}$$

N_m = adult male escapement estimate;

C_m = number of adult male carcasses examined for disk tags;

R_m = number of disk tagged or secondary marked adult males recovered;

V_f = variance of female escapement estimate, analogous to above.

Sex Identification Correction: The disk tag application data were corrected for sex identification error. Error occurred because the development of sexually dimorphic traits was often not advanced and internal examinations could not be made. Correction of recovery data was unnecessary because all carcasses were incised and examined internally. Sex identification error was corrected as described by Staley (1990):

3) Estimated true number of males released with disk tags and secondary marks (M_m):

$$M_m = \frac{M'_m - (M_t R_{m,f})/R_f}{1 - (R_{m,f}/R_f) - (R_{f,m}/R_m)}$$

where:

M'_m = field estimate of number of males released with disk tags and secondary marks;

M_t = total number of coho adults released with disk tags and secondary marks;

$R_{m,f}$ = number of females recovered with disk tags which were released as males;

$R_{f,m}$ = number of males recovered with disk tags which were released as females;

R_f = number of females recovered with disk tags;

R_m = number of males recovered with disk tags.

4) Estimated true number of females released with disk tags and secondary marks (M_f):

$$M_f = M_t - M_m$$

Adipose Fin Clipped Escapement: The estimated AFC escapement was the product of the AFC incidence in the carcass recovery sample, the largest of the two available samples, and the mark-recapture escapement estimate. Ninety-five percent confidence limits were calculated from the respective upper and lower confidence limits of the AFC incidence and the escapement estimate. For example, the upper 95% confidence limit of the AFC escapement estimate was the product of the upper limit of the AFC incidence and the upper limit of the total mark-recapture estimate. The mathematical relationships are reported below (Cochran 1977):

5) Estimated AFC escapement (N_a):

$$N_a = p(N_t)$$

6) Estimated 95% confidence limits for p:

$$p \pm 1.96\ (se + fpc)$$

where:

p = proportion of the sample with an AFC;

se = standard error;

$= (1-f)pq/(n-1)$

fpc = finite population correction;

$= \frac{1}{2n}$

n = sample size;

q = 1-p

$f = \frac{n}{N_t}$

Coded Wire Tagged Escapement: Escapement by CWT code and long term

CWT loss were calculated by applying the CWT composition in the carcass recovery sample to the estimated escapement of AFC adults. Apparent CWT loss was adjusted for post-mortality loss resulting from carcass decomposition and predator activity, when appropriate.

HARVEST SAMPLING

This report summarizes the estimated harvest by CWT group for the 1984-1988 broods; 1989 brood estimates have not been finalized and will be provided in a later report. Harvest data were obtained from the coast-wide harvest sampling program, supported by government management agencies in British Columbia, Alaska, Washington, Oregon and California, conducted to enable estimation of fishery contributions of CWT groups. In British Columbia, commercial harvest statistics were compiled by the Department of Fisheries and Oceans for 32 statistical areas and 14 catch regions (statistical area aggregates). Salmon landings by the commercial fishery were sampled for AFCs with the objective of examining 20% of the harvest by gear type, week and statistical area. The fishery contribution of each CWT group was estimated, by area and time, from the number of observed recoveries and the estimated proportion of the harvest examined for marks.

Harvest estimates by CWT group were obtained by catch region, gear and month from the regional mark recovery program data base (Kuhn *et al.* 1988). These data were then corrected, when appropriate, for two sampling problems. First, observed recoveries were not expanded for a time-area stratum if the proportion of the catch sampled (C:S) was too small to provide reliable results. Because rigorous statistical procedures were unavailable, we arbitrarily rejected strata where the C:S exceeded 10.0 if the sample totalled less than 10,000 coho and five recoveries of the CWT group of interest. Second, some troll recoveries could not be isolated to a single catch region. In these cases, we combined the sample and harvest data for those regions in that week to compute a new C:S ratio for that recovery.

Salmon River coho salmon were also vulnerable to the sport and native fisheries in the lower Fraser River. Harvest could not be estimated because the fishery was not sampled for AFCs and, in the native fishery, voluntary head returns were unavailable.

RESULTS

JUVENILE PROGRAM

Fish Capture

Catch of coho smolts totalled 23,169 in 1990, 9,904 in Salmon River and 13,265 in Coghlan Creek (Appendix 1). The 50% migration and the peak daily catch occurred on May 5 and May 4, respectively, in the Salmon River, and on May 7 and May 4, respectively, in Coghlan Creek. Low water flow made the traps inoperable for two days in Coghlan Creek and five days in Salmon River. The reported timing of the 1990 smolt migration, therefore, may be biased.

Coded Wire Tagging

AFC and CWT releases totalled 22,383 coho smolts in 1990 (Appendix 2). When adjusted for long term CWT loss (8.3%)(Appendix 9) and short term (24-hour) post tagging mortality (47), the number released with CWTs and identifiable AFCs was 20,390.

Short term CWT loss averaged 0.9% (range 0.0% to 11.8%). The incidence of disease, damage, or structural anomalies averaged 10.9% (Appendix 3). The most prevalent condition was "fog eye" (10.5%), a

reversible condition associated with capture stress. No naturally missing adipose fins were observed.

Coho Smolt Age and Size

Coho emigrated from the Salmon River system as yearling (age 1+) (99.6%) and two year old (age 2+) (0.4%) smolts. Smolt size averaged 92.9 mm and 8.3 g in the Salmon River and 95.8 mm and 8.8 g in Coghlan Creek (Appendix 4). Weighted mean smolt size was 94.6 mm and 8.6 g. Smolt size declined through the migratory period in both Salmon River and Coghlan Creek.

ADULT PROGRAM

Mark-Recapture

Disk Tag Application: Four hundred and five coho adults were released with disk tags and secondary marks from November 6 to December 20, 1991 (Table 1)(Appendix 5). Of that total, 87 had AFCs. Condition at release was good with 10 (2.5%) requiring ventilation (Table 2). No difference ($p > 0.05$; chi-square) was noted in the proportion of this group recovered on the spawning grounds.

An estimated 2.9% of the males and 0.0% of the females were misidentified at the time of tagging (Appendix 6). When adjusted for sex identification error, an estimated 213 (52.6%) males and 192 (47.4%) females were released with disk tags and secondary marks.

Spawning Ground Recovery: Six hundred and ninety-eight adults and 21 jacks were recovered on the spawning grounds from December 2, 1991 to January 14, 1992 (Table 1; Appendix 7). Of the adults, 66 (9.5%) had disk tags or secondary marks. Of the adults identified by sex, 346 (49.7%) were male and 350 (50.3%) were female while of those with AFC status recorded, 72 (10.4%) had an AFC. Of those with disk tags or secondary marks, 3 (4.5%) had no secondary mark and 1 (1.5%) had lost the disk tag. At these levels, the incidence of fish which may have lost both marks would not have influenced study results. None of the jacks had an AFC, and 16 of the AFC adults were disk tagged. The proportion of the disk tagged AFC coho which was recovered (18.4%) was not significantly different ($p > 0.05$; chi square) than that of disk tagged coho with no AFC (15.7%).

Sampling Selectivity

Period: Temporal bias in the application sample was examined by comparing between periods the mark incidence in the recovery sample (Table 3). Male and female mark incidences in the late recovery period were significantly lower than those in the earlier periods ($p < 0.05$; chi square).

Recovery bias was examined by stratifying the application sample by period and comparing the proportions recovered (Table 4). No significant difference ($p < 0.05$) was noted.

Location: Spatial bias in the application sample was examined by comparing between sections the mark incidence in the recovery sample (Table 5). Mark incidence, which ranged from 2.9% to 14.2%, was significantly different from that expected ($p < 0.05$; G-test) with the greatest difference observed in the middle section of Salmon River.

Recovery bias was examined by stratifying the application sample by section and comparing the proportions recovered (Table 6). A significant difference ($p < 0.05$) was noted, with the greatest difference observed in the upper section of Coghlan Creek.

Table 1. Disk tag application, carcass examination, and mark recovery, by sex, of Salmon River system coho adults, 1991-1992.

	Disk tags applied	Carcasses examined[b]	Marked carcasses recovered[b]				
			Disk tag and secondary mark	Secondary mark only	Disk tag only	Total	Percent recovered
Male	213[a]	346	34	1	0	35	16.4%
Female	192[a]	350	28	0	1	29	15.1%
Adipose present	318	622	47	1	2	50	15.7%
Adipose absent	87	72	15	0	1	16	18.4%
Total	405	698[c,d]	62	1	3[c]	66[c]	16.3%

[a] Adjusted for sex identification errors.
[b] Jacks excluded.
[c] Includes 2 of unknown sex.
[d] Includes 4 of unknown AFC status.

Table 2. Disk tag application and recovery of Salmon River system coho adults, by release condition, 1991-1992.

Release condition	Disk tags applied	Disk tags recovered	Percent recovered
Fish swam away without assistance	395	65	16.5%
Fish required ventilation	10	0	0.0%
Total	405	66[a]	16.3%

[a] Includes 1 with a secondary mark only.

Table 3. Incidence of disk tags or secondary marks in coho adults recovered on the Salmon River system spawning grounds, by period and sex, 1991-1992.

Recovery period	Recovered with disk tag or secondary mark			Total recoveries[a]			Percent with disk tag or secondary mark		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
02-Dec to 12-Dec	8	15	23	79	93	172	10.1%	16.1%	13.4%
13-Dec to 22-Dec	19	16	37[b]	151	148	301[b]	12.6%	10.8%	12.3%
23-Dec to 14-Jan	2	4	6	116	109	225	1.7%	3.7%	2.7%
Total	29	35	66	346	350	698	8.4%	10.0%	9.5%

[a] Excludes jacks.
[b] Includes 2 of unknown sex

Table 4. Proportion of the disk tag application sample recovered on the Salmon River system spawning grounds, by application period, 1991-1992.

Application period	Disk tags applied	Marked carcasses recovered	Percent recovered
06-Nov to 13-Nov	137	21	15.3%
14-Nov to 28-Nov	207	33	15.9%
29-Nov to 20-Dec	61	11	18.0%
Total	405	66[a]	16.3%

[a] Includes 1 with a secondary mark only.

Fish Size: Size related bias in the application sample was examined by comparing the continuous POH length-frequency distributions of marked and unmarked spawning ground recoveries. No significant difference was noted in males or females ($p > 0.05$; Kolmogorov-Smirnov two sample test).

Recovery bias was examined by partitioning the application sample into recovered and non-recovered components and comparing the continuous NF length frequency distributions of each. Although the proportion recovered increased with NF length (Table 7), the difference was not significant ($p > 0.05$).

Fish Sex: Sex related bias in the application sample was examined by comparing the sex ratio of the marked and unmarked spawning ground recoveries (Table 8). No significant difference was noted ($p > 0.05$; chi-square).

Recovery bias was examined by partitioning the application sample into recovered and non-recovered components and comparing the sex ratio in each (Table 8). No significant difference was noted ($p > 0.05$). Furthermore, no significant difference was noted in the proportion of males (16.9%) and females (14.6%) released with disk tags and recovered on the spawning grounds (Table 1).

Spawning Success: Spawning success, estimated from the internal examination of female spawning ground recoveries, was estimated at 97.1% (Appendix 8). Spawning success of marked (94.8%) and unmarked (98.2%) females was significantly different ($p < 0.05$; difference in proportions test).

Estimation of Spawner Population

Total Escapement: The 1991-1992 escapement of Salmon River coho adults, calculated from mark-recapture data, was 4,321 (Table 9). Upper and lower 95% confidence limits were 5,308 and 3,334, respectively. The escapement of female and male coho adults was 2,258 and 2,063, respectively.

Adipose Fin Clipped Adults: Based on the coho adult AFC incidence in the spawning ground sample (10.4%; Table 1), the 1991-1992 escapement of AFC adults was 448, with upper and lower 95% confidence limits of 544 and 352, respectively (Table 9). Of that total, an estimated 299 returned with CWT code 02 08 34, 106 with CWT code 02 08 35, 6 with CWT code 02 08 36, and 37 (8.3%) had lost the CWT (Appendix 9). CWT loss was not influenced by carcass condition or predators ($p > 0.05$; chi-square) (Appendix 10). Survival from smolt release to adult escapement averaged 2.0%; however, survival for the three CWT codes, ranging from 0.3% to 3.1%, were significantly different ($p < 0.05$, chi-square)(Table 10). There were significant differences in both the location of recovery and the recovery periods of Coghlan Creek CWTs (codes 02 08 34 and 02 38 36) and Salmon River CWTs (code 02 08 35)($p > 0.05$, chi-square)(Table 10).

Age, Length and Sex

The age and length of 156 coho salmon recovered on the spawning grounds is summarized by sex in Appendix 11. All males and females were age 3_2. Mean NF length of males and females in the application sample was 52.7 cm and 56.3 cm, respectively (Appendix 11). No significant difference ($p > 0.05$; ANOVA) was noted between those with and without an AFC. Females were significantly longer than males ($p < 0.05$; ANOVA). Mean POH length of males and females in the recovery sample was 43.9 cm and 47.9 cm, respectively (Appendix 11). No significant difference ($p > 0.05$; ANOVA) was noted between those

Table 5. Incidence of disk tags and secondary marks, by section, in the Salmon River system spawning ground recovery sample, 1991-1992.

Location	Section[a]	Carcasses examined		Carcasses recovered with disk tags or secondary marks	
		Number[b]	Percent of total	Number	Mark Incidence
Salmon River	Lower	113	16.2%	11	9.7%
	Middle	69	9.9%	2	2.9%
	Upper	206	29.5%	11	5.3%
Coghlan Creek	Lower	127	18.2%	18	14.2%
	Upper	183	26.2%	24	13.1%
Total	-	698	100.0%	66	9.5%

[a] Salmon River: lower - S1 and S2; middle - S3; upper - S4 and S5;
Coghlan Creek: lower - C1; upper - C2, C3, C4 and C5.
[b] Excludes jacks.

Table 6. Proportion of the disk tag application sample recovered on the Salmon River system spawning grounds, by application section, 1991-1992.

Location	Section[a]	Disk tags applied		Disk tags recovered	
		Number	Percent of total	Number	Percent recovered
Salmon River	Lower	97	24.0%	10	10.3%
	Middle	47	11.6%	5	10.6%
	Upper	87	21.5%	10	11.5%
Coghlan Creek	Lower	56	13.8%	10	17.9%
	Upper	118	29.1%	30	25.4%
Total	-	405	100.0%	66[b]	16.3%

[a] See Table 5 for section descriptions.
[b] Includes 1 with a secondary mark only.

Table 7. Disk tag application and recovery of Salmon River system coho adults, by nose-fork length, 1991-1992.

Nose-fork length (cm)	Disk tags applied	Carcasses recovered with disk tags	Percent recovered
30-39	9	0	0.0%
40-49	74	8	10.8%
50-59	229	38	16.6%
60-69	88	18	20.5%
70-79	2	1	50.0%
Total	405[a]	66[b]	16.3%

[a] Includes 3 coho adults not measured at release.
[b] Includes 1 with a secondary mark only.

Table 8. Sex composition of Salmon River system coho adults in the disk tag application and spawning ground recovery samples, 1991-1992.

		Application sample[a]			Spawning ground recovery sample[b]		
Sex		Recovered	Not Recovered[c]	Total	Disk tag or secondary mark	Unmarked	Total
Male	N	35	178	213	35	311	346
	%	54.7	52.2	52.6	54.7	49.2	49.7
Female	N	29	163	192	29	321	350
	%	45.3	47.8	47.4	45.3	50.8	50.3
Total		64[d]	341	405	66[c]	632	698[c]

[a] Corrected for sex identification error.
[b] Excludes jacks.
[c] Includes 2 recovered with unknown sex.
[d] Excludes 2 of unknown sex.

Table 9. Escapement estimates, by sex and AFC status, for Salmon River system coho adults, 1991-1992.

	Escapement estimate	95% confidence limit	
		Lower	Upper
Male	2,063	1,433	2,692
Female	2,258	1,498	3,018
Total	4,321	3,334	5,308
AFC Adult	448	352	544

Table 10. Smolt release, adult escapement and survival to adult escapement of coded wire tagged 1988 brood Salmon River system coho salmon.

	CWT Code					
	02 08 34	02 08 35	02 08 36	Total	No pin	Total
Number released[a]	9,709	8,833	1,848	20,390		20,390
Spawning ground recoveries						
Location						
Salmon River	6	15	1	22	1	23
Coghlan Creek	42	2	0	44	5	49
Recovery Period						
02-Dec to 12-Dec	34	5	0	39	2	41
13-Dec to 22-Dec	9	8	1	18	3	21
23-Dec to 14-Jan	5	4	0	9	1	10
Total	48	17	1	66	6	72
Percent of recovering	66.7	23.6	1.4	91.7	8.3	
Estimated escapement	299	106	6	411	37	448
Survival to escapement	3.1%	1.2%	0.3%	2.0%	-	-

[a] Adjusted for long term tag loss

with and without an AFC. Females were significantly longer than males ($p < 0.05$; ANOVA).

Females comprised 47.4% of the application sample, 53.3% of the recovery sample (Table 8) and 52.3% of the Petersen population estimate.

DISCUSSION

GENERAL

Juvenile Program

The 1988 brood release of 20,390 coded wire tagged coho smolts was similar to the 1984-1987 brood average release of 19,865 (Table 11). The subsequent AFC incidence in the 1991-1992 adult escapement (10.3%) was also similar to the four year average (10.5%), suggesting that smolt catchability has not varied dramatically over the study period.

Long term CWT loss (8.3%) was less than the four year average (14.4%), but within the 1984-87 brood range of 6.2% to 21.6% (Table 11).

Adult Program

The apparent efficiency of the 1991-1992 field activities was similar to that reported in previous years (Table 12). The proportion of the escapement which was marked with disk tags was 1.1 percentage points above average, while the proportion of the escapement censused and the proportion of the marks recovered were 2.7 percentage points and 2.5 percentage points below average, respectively (Table 12). These data reflect the pattern of freshets in 1991-1992, which occurred after during the die-off period after immigration was complete.

ADULT CAPTURE TECHNIQUE

A basic assumption underlying Petersen mark-recapture studies is that capture and tagging must not influence the subsequent catchability of the fish. Previous studies in the Salmon River (Schubert and Kalnin 1990; Kalnin and Schubert 1991; Farwell **et al.** 1991; Farwell **et al.** 1992) reported differences in the spawning success of marked and unmarked females in most years, suggesting that exposure to electric current influenced subsequent survival. The present study also showed a small but significant difference in spawning success of marked and unmarked females; however, we were unable to determine if a behavioural change associated with reduced spawning success would also influence subsequent catchability.

SAMPLING SELECTIVITY

A second assumption underlying Petersen mark-recapture studies is that the population is sampled in a random or representative manner (Ricker 1975). In studies when nonrepresentative sampling occurs, accurate results may still be achieved if one sample is representative (Robson 1969). As in previous years, it was not possible to test for representativeness because the true population parameters were not known. Instead, we examined the samples for four biases, temporal, spatial, fish size and fish sex, as indicators of weaknesses in the study design. Biases were identified in both the tag application and recovery samples (Table 13). The application sample had a spatial and temporal bias, while the recovery sample had a spatial bias.

The spatial bias in both the application and recovery samples could potentially bias study results; however, because the direction of the biases were dissimilar, estimation error may have been minor. To investigate this assumption, we stratified the data by section and estimated the escapement using Schaefer's modifica-

Table 11. Smolt release, escapement, survival and long term CWT loss in 1984-1988 brood Salmon River coho salmon.

Dominant brood year	Dominant escapement year	Number smolts released with CWTs	Escapement		CWT escapement	Survival to escapement (%)	Long term CWT loss	Percent escapement with AFCs
			Female	Total				
1984	1987-88	7,891	5,197	11,947	373	4.7%	21.6%	3.4%
1985	1988-89	20,022	5,779	9,152	1,082	5.4%	13.5%	14.4%
1986	1989-90	24,634	4,458	8,427	864	3.5%	6.2%	10.9%
1987	1990-91	26,911	3,037	4,986	791	2.9%	18.4%	19.4%
Mean	-	19,865	4,618	8,628	778	3.9%	14.4%	10.5%
1988	1991-92	20,390	2,258	4,321	409	2.0%	8.3%	10.3%

Table 12. Adult study efficiency as indicated by the proportion of the Salmon River adult escapement which was disk tagged, censused, and recovered, 1987-88 to 1991-1992.

Year	Escapement	Application Sample		Census sample		Marks recovered	
		Total	Percent of total escapement	Total	Percent of total escapement	Total	Percent recovered
1987-88	11,947	1,322	11.1%	3,302	27.6%	352	26.6%
1988-89	9,152	717	7.8%	1,377	15.0%	107	14.9%
1989-90	8,427	495	5.9%	1,327	15.7%	80	16.2%
1990-91	4,986	430	8.6%	864	17.3%	75	17.4%
Mean	8,628	741	8.3%	1,718	18.9%	154	18.8%
1991-92	4,321	405	9.4%	698	16.2%	66	16.3%

Table 13. Results of statistical tests for bias in the 1991-1992 Salmon River escapement estimation study.

Test	Application Sample	Recovery Sample
Period	Bias in late period	No Bias
Location	Bias in middle Salmon River	Bias in upper Coghlan Creek
Fish size	No bias	No bias
Fish sex	No bias	No bias

Table 14. Smolt to adult survival and exploitation rate of 1984-1987 brood Salmon River coho salmon.

	Dominant Brood Year			
	1984	1985	1986	1987
Number released with a CWT a	7,891	20,022	24,634	26,911
Fishery Harvest b				
Age 2	0	10	4	4
Age 3	802	3,123	2,061	2,602
Age 4	3	0	0	7
Total	805	3,133	2,065	2,613
Percent of release	10.2%	15.6%	8.4%	9.7%
Adult Escapement				
Age 3	319	1,082	864	791
Age 4	54	0	0	0
Total	373	1,082	864	791
Survival to harvest and escapement				
Number	1,178	4,215	2,929	3,404
Percent of release	14.9%	21.1%	11.9%	12.6%
Exploitation Rate	68.3%	74.3%	70.5%	76.8%

a. Adjusted for long term CWT loss.

b. From Appendix 12.

tion of the Petersen method for use with stratified populations (Ricker 1975). This estimate (4,228) was 2.1% lower than the Petersen estimate but well above its lower 95% confidence limit. We concluded, therefore, that the assumption was valid; however, because similar spatial biases have been reported in previous studies (Farwell et al. 1991, 1992), spatial patterns should be assessed before undertaking future studies.

ESCAPEMENT TREND

The 1991-1992 escapement of 4,321 was the fourth consecutive year of coho escapement declines in the Salmon River (Table 11). Escapement declined by 13% from 1990-1991 and by 64% from 1987-1988, the first year of this study (Table 11). Female escapement declined by 26% and 57% during the same periods.

SURVIVAL AND EXPLOITATION RATE

Exploitation rates and smolt to adult survivals were computed for the 1984-1987 brood years (Table 13); 1988 brood harvest data are preliminary and will be report in a future document. Exploitation rates for the 1984-1987 brood years averaged 72.3% (range 68.0% to 76.7%). This level was slightly above the 65%-70% range believed to be associated with maximum sustained production, but below

the the average 77.1% reported for lower Fraser River hatchery stocks (DFO MS 1990). Smolt to adult survival averaged 15.1%.

SUMMARY

1. The Salmon River (Langley) coho stock is one of a group of British Columbia stocks being monitored to evaluate responses to management actions by measuring, with known precision, annual escapement, marine survival, harvest distribution, and exploitation rate.

2. Coded wire tags (CWTs) and adipose fin clips (AFCs) were applied to emigrant smolts from April 20 to June 4, 1990. Smolts were captured at fence traps in the Salmon River and Coghlan Creek, the principal tributary. Tagged smolts were transported and released downstream of a pumphouse at the river mouth.

3. A total of 20,390 coho smolts were release with CWTs and AFCs. Size averaged 94.6 mm NF length and 8.6 g wet weight.

4. Adult spawners were enumerated by a mark-recapture study from November 6, 1991 to January 14, 1992. Coho adults were captured using an electroshocker and marked with Petersen disk tags and opercular punches. The escapement was censused by the recovery of carcasses following spawning.

5. The 1991-92 coho adult escapement was estimated from a disk tag application sample of 405, a recovery sample of 698, and a recovery of 66 carcasses with disk tags or secondary marks. The estimated escapement was 4,321 coho adults, of which 2,258 were female, 2,063 were male, and 448 had AFCs.

6. The estimated return to the spawning grounds of CWT codes 02 08 34, 02 08 35, and 02 08 36 were 299, 106, and 6, respectively. Survival from smolt release to spawning ground recovery for these three CWT codes was 3.1%, 1.2%, and 0.3%, respectively, while CWT loss was 8.3%.

7. All coho adults, as measured from the recovery sample, were age 3_2. Adult POH length averaged 43.9 cm for males and 47.9 cm for females.

8. Biases were identified in both the application and recovery samples. None of the biases were likely to have influenced the accuracy of the escapement estimate.

9. For 1984-1987 brood years, smolt to adult survival averaged 15.1%, and exploitation rate averaged 72.3%.

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APPENDICES

Appendix 1a. Daily fence trap catches in the Salmon River, 1990.

Date	Water temp. (C) a	Water level (m) a	Coho smolt	Cutthroat		Rainbow		Lamprey	Sculpin	Stickle-back	Cray-fish	Sucker
				Smolt	Parr	Smolt	Parr					
24-Apr	7.0	0.65	293	7	1	6	1	2	0	2	0	0
25-Apr	7.0	0.66	592	110	3	187	10	1	0	0	0	0
26-Apr	7.0	0.85	125	3	2	1	1	1	1	2	0	0
27-Apr	6.0	0.61	58	13	0	20	1	2	1	2	0	0
28-Apr	6.0	0.72	11	1	0	1	0	1	0	0	0	0
29-Apr b	8.0	0.61	-	-	-	-	-	-	-	-	-	-
30-Apr	5.0	0.55	30	0	0	0	0	0	0	1	0	0
01-May	7.0	0.50	826	50	1	50	2	3	1	0	1	0
02-May	7.0	0.53	1033	107	1	90	1	1	1	1	0	1
03-May	7.0	0.52	406	50	3	55	1	1	0	0	1	0
04-May	8.0	0.49	1197	83	0	77	8	1	2	0	0	0
05-May	9.0	0.48	921	81	5	26	3	0	0	0	0	0
06-May	7.5	0.48	2	0	0	0	0	4	0	1	1	0
07-May b	7.0	0.49	-	-	-	-	-	-	-	-	-	-
08-May	7.0	0.48	330	6	4	2	5	0	0	0	0	0
09-May	7.0	0.47	338	4	4	8	7	1	1	0	0	0
10-May	8.0	0.47	340	8	1	1	1	0	0	0	0	0
11-May b	9.0	0.47	-	-	-	-	-	-	-	-	-	-
12-May	7.0	0.48	72	63	8	3	2	5	2	0	0	0
13-May	7.0	0.49	150	57	2	25	15	1	1	0	0	0
14-May	7.0	0.50	108	84	9	16	8	2	1	0	0	0
15-May	7.0	0.50	126	59	5	6	5	2	0	0	1	0
16-May	8.0	0.49	195	65	1	8	5	2	0	0	0	0
17-May	7.5	0.48	338	46	2	8	5	0	2	0	1	0
18-May	8.0	0.50	71	24	3	4	4	1	2	0	0	0
19-May b	9.0	0.50	-	-	-	-	-	-	-	-	-	-
20-May b	7.5	0.53	-	-	-	-	-	-	-	-	-	-
21-May b	7.5	0.54	-	-	-	-	-	-	-	-	-	-
22-May	8.5	0.53	59	1	0	0	0	0	0	0	0	0
23-May	8.0	0.51	606	16	2	2	2	1	1	0	2	0
24-May	8.0	0.50	233	9	2	1	1	2	0	0	0	0
25-May	8.0	0.49	218	6	1	0	0	2	0	0	0	0
26-May	9.0	0.48	43	6	4	0	2	0	0	0	0	0
27-May	8.5	0.48	108	25	1	0	1	0	0	0	0	0
28-May	9.0	0.49	172	10	3	3	2	0	1	0	0	0
29-May	9.0	0.49	212	18	1	0	0	0	3	0	1	0
30-May	9.0	0.48	86	6	4	1	0	1	0	0	1	0
31-May	9.0	0.50	131	1	3	1	3	0	2	0	0	0
01-Jun	8.0	0.56	202	44	22	1	4	0	3	0	0	0
02-Jun	10.0	0.56	153	15	6	0	0	0	0	0	0	0
03-Jun	8.0	0.83	119	62	18	2	15	1	1	1	0	0
04-Jun c	9.0	2.18	-	-	-	-	-	-	-	-	-	-
Total	-	-	9,904	1,140	122	605	115	38	26	10	9	1

a. Recorded at approximately 0800 hrs.
b. Trap not fishing due to low water.
c. Trap out due to high water.

Appendix 1b. Daily fence trap catches in Coghlan Creek, 1990.

Date	Water temp. (C) a	Water level (m) a	Coho smolt	Cutthroat Smolt	Cutthroat Parr	Rainbow Smolt	Rainbow Parr	Lamprey	Sculpin	Stickle-back	Cray-fish	Sucker
20-Apr	8.0	0.85	21	5	2	5	0	1	0	0	0	0
21-Apr	7.0	0.89	13	33	0	51	2	2	0	0	0	0
22-Apr	7.0	0.77	6	8	0	0	0	0	0	0	0	0
23-Apr	7.0	1.11	282	65	6	55	0	2	1	1	0	0
24-Apr	7.0	1.03	214	72	12	5	0	0	0	1	0	0
25-Apr	6.0	1.18	138	29	4	29	3	1	0	2	1	0
26-Apr	7.0	1.00	330	61	1	21	0	0	1	4	0	0
27-Apr	6.0	0.97	54	39	1	9	0	1	0	1	0	0
28-Apr	5.0	1.05	261	28	3	12	2	0	0	1	0	0
29-Apr	8.0	0.95	70	17	1	2	1	1	0	0	0	0
30-Apr	5.0	0.90	509	116	0	40	3	2	1	0	0	0
01-May	6.0	0.88	658	124	7	27	7	0	0	0	0	0
02-May	6.5	0.88	475	89	4	15	5	1	0	2	0	0
03-May	6.0	0.88	918	89	2	20	6	2	0	1	0	0
04-May	7.0	0.85	1009	152	6	28	15	0	1	1	0	0
05-May	8.0	0.82	930	224	12	18	1	0	0	0	1	0
06-May	6.5	0.72	627	174	3	17	26	1	0	0	0	0
07-May	7.0	0.82	497	35	1	6	2	0	0	0	0	0
08-May	7.0	0.82	379	56	1	8	6	1	1	0	0	0
09-May	6.0	0.80	607	114	4	2	5	2	1	0	0	0
10-May	7.0	0.80	562	114	8	4	4	2	1	0	0	0
11-May	8.0	0.80	471	111	0	4	6	1	1	0	1	0
12-May	7.0	0.85	410	218	5	3	1	0	1	0	0	0
13-May	6.5	0.83	595	86	2	4	2	1	0	0	0	0
14-May	6.0	0.85	252	101	1	2	1	1	0	0	0	0
15-May	7.0	0.80	429	116	3	6	2	0	1	1	0	0
16-May	7.0	0.82	355	103	3	6	4	0	0	0	1	0
17-May	7.0	0.80	317	103	3	1	4	0	0	0	0	0
18-May	7.0	0.86	284	97	4	1	4	0	1	0	0	0
19-May b	8.0	0.85	-	-	-	-	-	-	-	-	-	-
20-May b	7.0	0.85	-	-	-	-	-	-	-	-	-	-
21-May	7.0	0.84	63	38	0	0	0	4	0	1	1	0
22-May	7.5	0.81	208	3	1	3	0	0	0	0	1	0
23-May	7.0	0.80	308	106	3	6	5	2	0	0	0	0
24-May	7.0	0.80	187	46	4	1	2	2	0	0	0	0
25-May	7.0	0.79	166	35	5	3	1	3	0	0	0	0
26-May	8.0	0.79	119	47	3	1	0	0	0	0	0	0
27-May	7.5	0.80	64	37	1	0	1	3	0	0	1	0
28-May	8.0	0.80	43	41	4	1	1	0	0	0	0	0
29-May	8.5	0.79	136	54	5	1	3	0	0	0	0	0
30-May	8.0	0.80	74	55	4	1	3	3	0	0	0	0
31-May	8.0	0.82	49	41	3	1	1	0	0	0	0	0
01-Jun	7.5	0.95	126	77	7	2	3	0	0	0	0	0
02-Jun	9.0	0.93	49	72	3	0	0	1	0	0	0	0
03-Jun c	8.0	1.55	-	-	-	-	-	-	-	-	-	-
Total	-	-	13,265	3,231	142	421	132	40	11	16	7	0

a. Recorded at approximately 0800 hrs.
b. Trap not fishing due to low water.
c. Trap out due to high water.

Appendix 2a. Salmon River coded wire tagging results (code 02 08 35), 1990.

Tagging date	Maximum holding time (days)	Pre-tagging mort-ality	Total number marked	24-hour CWT rejection		Post tagging mortality		Total released with CWT c
				N a	(%)	Immediate	24-hour b	
24-Apr	1	1	228	193	1.6	1	0	208
25-Apr	1	1	576	179	2.2	1	21	508
26-Apr	1	1	122	-	-	0	0	112
30-Apr	3	0	63	102	0.0	0	0	58
01-May	1	40	764	222	1.4	17	6	679
02-May	1	2	1124	271	1.5	7	0	1,024
03-May	1	0	410	183	1.1	4	2	370
04-May	1	12	1182	295	0.0	6	1	1,077
07-May	2	4	922	270	0.4	0	0	845
08-May	1	4	325	99	1.0	0	0	298
09-May	1	1	337	253	0.0	0	0	309
10-May	1	1	338	338	0.0	0	0	310
14-May	2	2	325	343	0.3	0	0	298
15-May	1	0	121	121	0.0	3	0	108
16-May	1	2	189	188	0.5	2	2	170
17-May	1	0	339	339	2.9	1	0	310
18-May	1	0	79	78	0.0	0	1	72
22-May	1	1	59	59	0.0	0	0	54
23-May	1	0	605	306	0.0	0	0	555
24-May	1	0	233	233	0.4	0	1	213
25-May	1	0	217	212	0.5	0	0	199
28-May	2	1	260	-	-	0	0	238
29-May	1	3	209	-	-	0	0	192
30-May	1	1	85	-	-	0	0	78
01-Jun	1	0	331	156	0.0	0	3	301
04-Jun	2	0	272	-	-	0	0	249
Total (mean)	(1.2)	77	9,715	4,440	(0.7)	42	37	8,833

a. Sample size held to assess tag loss.
b. Based on mortality rate observed in QCD subsample expanded to entire tag lot.
c. Adjusted for long term CWT loss (see text).

Appendix 2b. Coghlan Creek coded wire tagging results (codes 02 08 34 and 02 08 36), 1990.

CWT code	Tagging date	Maximum holding time (days)	Pre-tagging mortality	Total number marked	24-hour CWT rejection		Post tagging mortality		Total released with CWT c
					N a	(%)	Immediate	24-hour b	
02 08 34	24-Apr	4	0	500	213	0.5	12	0	447
	26-Apr	1	3	359	100	2.0	3	0	326
	30-Apr	3	5	895	239	0.4	3	0	818
	01-May	1	1	653	219	0.0	3	1	595
	02-May	1	3	471	204	11.8	1	0	431
	03-May	1	1	917	263	1.1	0	0	841
	04-May	1	11	878	193	0.0	16	0	790
	07-May	2	19	1754	274	0.4	0	0	1,608
	08-May	1	0	377	129	1.6	1	0	345
	09-May	1	1	607	238	0.4	0	0	556
	10-May	1	3	555	129	0.0	3	0	506
	11-May	1	3	461	150	0.0	7	0	416
	14-May	2	9	1260	345	1.2	0	1	1,154
	15-May	1	0	426	362	0.6	1	0	390
	16-May	1	1	354	213	1.4	0	0	325
	17-May	1	0	178	175	0.0	0	1	162
	Total (mean)	(1.4)	60	10,645	3,446	(1.3)	50	3	9,709
02 08 36	22-May	4	3	679	268	0.0	0	1	622
	23-May	1	0	305	222	0.5	0	0	280
	24-May	1	0	187	186	2.7	0	1	171
	25-May	1	0	154	152	0.7	0	0	141
	28-May	2	0	270	254	0.0	0	0	248
	29-May	1	0	135	135	0.7	0	0	124
	30-May	1	0	74	-	-	0	2	66
	01-Jun	1	0	169	129	0.8	0	3	152
	04-Jun	2	0	50	-	-	0	0	46
	Total (mean)	(1.6)	3	2,023	1,346	0.8	0	7	1,848
Total (mean)		(1.5)	63	12,668	4,792	1.1	50	10	11,557

a. Sample size held to assess tag loss.
b. Based on mortality rate observed in QCD subsample expanded to entire tag lot.
c. Adjusted for long term CWT loss (see text).

Appendix 3. Incidence of anomalies encountered while coded wire tagging Salmon River system coho salmon smolts, 1990.

Location	Number inspected	Fog eye	Neascus	Crinkle-back	General damage	Natural AFC
Salmon River	9,977	1,040	22	2	18	0
	%	10.4	0.2	0.02	0.2	0.0
Coghlan Creek	12,402	1,301	31	3	23	0
	%	10.5	0.2	0.02	0.2	0.0
Total	22,379	2,341	53	5	41	0
	%	10.5	0.2	0.02	0.2	0.0

Appendix 4. Mean length and weight of coho salmon smolts in the Salmon River System, 1990.

Location	Sample date	Sample size	Nose-fork length (mm) Mean	Nose-fork length (mm) Standard deviation	Mean weight (g)
Salmon River	24-Apr	50	99.8	14.1	10.5
	27-Apr	50	99.6	15.1	10.5
	01-May	50	94.8	10.0	8.5
	04-May	50	94.8	10.3	8.9
	08-May	50	92.5	8.6	8.0
	11-May	50	89.6	7.2	7.4
	15-May	50	90.3	8.6	7.8
	18-May	50	91.0	7.6	7.9
	22-May	50	90.5	9.9	7.3
	25-May	50	88.9	7.3	7.0
	29-May	50	87.9	5.7	7.1
	01-Jun	50	89.4	6.1	6.9
	Total a	600	92.9	-	8.3 a
Coghlan Creek	24-Apr	50	103.6	11.4	11.6
	27-Apr	50	105.4	12.1	11.8
	01-May	50	99.7	8.7	10.1
	04-May	50	97.0	6.8	9.0
	08-May	50	96.5	7.4	9.1
	11-May	50	93.2	6.5	7.8
	15-May	50	93.2	7.0	8.0
	18-May	50	92.8	7.3	8.0
	22-May	50	89.5	5.7	7.5
	25-May	50	90.7	6.3	7.3
	29-May	50	91.8	5.9	7.6
	01-Jun	50	91.7	7.6	7.8
	Total a	600	95.8	-	8.8 a
Total	-	1,200	94.6	-	8.6 a

a. Weighted by proportion of smolt migration in time periods.

Appendix 5a. Coho adult disk tag application results in the Salmon River, 1991. a

Date	Reach b	Adipose present			Adipose absent			Total		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
06-Nov	S1	1	16	17	1	4	5	2	20	22
	S2	1	1	2	0	0	0	1	1	2
08-Nov	S2	0	6	6	1	2	3	1	8	9
	S3	14	4	18	1	2	3	15	6	21
	S4	11	1	12	0	1	1	11	2	13
13-Nov	S5	1	2	3	0	1	1	1	3	4
15-Nov	S1	13	12	25	3	6	9	16	18	34
	S3	4	5	9	3	2	5	7	7	14
	S4	10	11	21	1	1	2	11	12	23
22-Nov	S1	4	5	9	0	0	0	4	5	9
	S3	7	5	12	0	0	0	7	5	12
	S4	6	5	11	1	3	4	7	8	15
	S5	3	4	7	0	1	1	3	5	8
29-Nov	S1	6	10	16	0	0	0	6	10	16
	S5	7	5	12	0	1	1	7	6	13
20-Dec	S1	3	2	5	0	0	0	3	2	5
	S4	7	3	10	0	1	1	7	4	11
Total	S1	27	45	72	4	10	14	31	55	86
	S2	1	7	8	1	2	3	2	9	11
	S3	25	14	39	4	4	8	29	18	47
	S4	34	20	54	2	6	8	36	26	62
	S5	11	11	22	0	3	3	11	14	25
	Total	98	97	195	11	25	36	109	122	231

a. Not corrected for sex identification error.

b. Salmon River reaches:
S1 - below Coghlan Creek.
S2 - Coghlan Creek to 64 Ave.
S3 - 64 Ave. to 56 Ave.
S4 - 56 Ave. to 248 St.
S5 - 248 St. to 256 St.

Appendix 5b. Coho adult disk tag application results in Coghlan Creek, 1991. a

Date	Reach b	Adipose present			Adipose absent			Total		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
06-Nov	C1	2	4	6	2	0	2	4	4	8
08-Nov	C1	4	3	7	2	0	2	6	3	9
13-Nov	C1	7	4	11	1	1	2	8	5	13
	C2	1	1	2	1	1	2	2	2	4
	C3	5	3	8	2	1	3	7	4	11
	C4	2	5	7	2	0	2	4	5	9
	C5	2	0	2	5	5	10	7	5	12
15-Nov	C1	9	1	10	1	0	1	10	1	11
18-Nov	C2	4	2	6	1	1	2	5	3	8
	C3	1	4	5	0	1	1	1	5	6
	C5	6	4	10	4	6	10	10	10	20
25-Nov	C1	2	5	7	2	0	2	4	5	9
	C2	12	5	17	3	0	3	15	5	20
	C4	0	5	5	0	0	0	0	5	5
	C5	2	3	5	6	2	8	8	5	13
06-Dec	C1	2	4	6	0	0	0	2	4	6
	C3	3	1	4	0	1	1	3	2	5
	C4	0	1	1	0	0	0	0	1	1
12-Dec	C3	2	2	4	0	0	0	2	2	4
Total	C1	26	21	47	8	1	9	34	22	56
	C2	17	8	25	5	2	7	22	10	32
	C3	11	10	21	2	3	5	13	13	26
	C4	2	11	13	2	0	2	4	11	15
	C5	10	7	17	15	13	28	25	20	45
	Total	66	57	123	32	19	51	98	76	174

a. Not corrected for sex identification error.

b. Coghlan Creek reaches:
C1 - Salmon River to Hwy. 1.
C2 - Hwy. 1 to 248 St.
C3 - 248 St. to 64 Ave.
C4 - 64 Ave. to 256 St.
C5 - Above 256 St.

Appendix 6. Disk tag recoveries in the Salmon River system, by application and recovery date and location, 1991-1992.

Application sample					Recovery sample					
Date	Reach d	NF length (cm)	Sex	Adipose fin	Date	Reach	POH length (cm)	Sex		Time out (days)
06-Nov	S1	49.5	M	A	18-Dec	C1	-	-	b	42
06-Nov	S1	55.5	F	P	18-Dec	C1	-	-	b	42
06-Nov	S1	64.0	F	P	13-Dec	S1	52.7	F		37
06-Nov	C1	55.0	F	P	02-Dec	C3	44.3	F		26
06-Nov	C1	55.5	M	P	13-Dec	S1	42.5	M		37
08-Nov	C1	56.0	M	P	13-Dec	S1	45.1	M		35
08-Nov	C1	51.0	M	A	04-Dec	C1	40.6	M		26
08-Nov	S3	50.0	M	P	13-Dec	S1	40.5	M		35
08-Nov	S2	50.0	M	A	13-Dec	S1	40.7	M		35
08-Nov	S2	46.5	F	P	13-Dec	S1	-	F	b	35
13-Nov	C2	58.0	F	A	04-Dec	C2	49.0	F		21
13-Nov	C3	71.5	M	P	04-Dec	C2	56.7	M		21
13-Nov	C3	61.0	F	P	02-Dec	C3	49.7	F		19
13-Nov	C3	54.5	M	A	02-Dec	C3	41.2	M		19
13-Nov	C5	65.0	M	P	02-Dec	C4	54.7	M		19
13-Nov	C5	59.0	F	A	02-Dec	C4	50.2	F		19
13-Nov	C5	52.0	M	A	02-Dec	C5	39.5	M		19
13-Nov	C5	62.0	M	A	13-Dec	C5	48.3	M		30
13-Nov	C4	47.0	M	P	04-Dec	C1	40.3	M		21
13-Nov	C1	52.0	M	A	04-Dec	C1	39.7	M		21
13-Nov	S5	62.5	F	P	18-Dec	S4	49.2	F		35
15-Nov	S3	50.0	M	A	23-Dec	S3	43.6	M		38
15-Nov	S3	53.0	M	P	06-Dec	S4	42.6	M		21
15-Nov	S1	60.0	M	P	18-Dec	C1	45.8	M		33
15-Nov	S1	57.5	F	P	23-Dec	C1	47.0	F		38
18-Nov	C3	53.0	F	P	18-Dec	C1	44.6	F		30
18-Nov	C5	53.0	F	P	02-Dec	C4	44.0	M	a	14
18-Nov	C5	58.0	F	P	02-Dec	C4	48.4	F		14
18-Nov	C5	53.0	M	P	02-Dec	C5	53.1	M	c	14
18-Nov	C5	58.0	F	P	02-Dec	C4	48.0	F		14
18-Nov	C5	51.0	M	P	02-Dec	C5	39.8	M		14
22-Nov	S3	49.0	M	P	13-Dec	S3	40.9	M		21
22-Nov	S3	63.5	F	P	18-Dec	S4	50.3	F		26
22-Nov	S4	58.0	F	P	13-Dec	C1	48.0	F		21
22-Nov	S4	52.0	F	P	18-Dec	S4	40.7	F		26
22-Nov	S5	57.5	M	P	18-Dec	S4	45.4	M		26
25-Nov	C1	59.0	M	P	18-Dec	C1	44.6	M		23
25-Nov	C1	66.5	F	P	13-Dec	S1	53.6	F		18
25-Nov	C1	61.5	M	A	18-Dec	C1	46.8	M		23
25-Nov	C2	63.0	M	P	23-Dec	C3	50.2	M		28
25-Nov	C2	48.5	M	P	04-Dec	C1	38.1	M		9
25-Nov	C2	48.0	M	P	04-Dec	C1	41.5	M		9
25-Nov	C2	57.0	F	P	18-Dec	C1	44.4	F		23
25-Nov	C2	55.0	M	P	23-Dec	C3	43.3	M		28
25-Nov	C2	68.0	M	P	02-Dec	C4	50.7	M		7
25-Nov	C4	61.0	F	P	18-Dec	C1	52.3	F		23
25-Nov	C4	63.0	F	P	13-Dec	C4	51.8	F		18
25-Nov	C4	58.0	F	P	02-Dec	C4	47.5	F		7
25-Nov	C5	56.0	M	A	03-Jan	C5	42.4	M		39
25-Nov	C5	53.5	F	P	02-Dec	C4	45.0	F		7
25-Nov	C5	45.0	F	P	13-Dec	C4	37.6	F		18

Appendix 6. Disk tag recoveries in the Salmon River system, by application and recovery date and location, 1991-1992.

Application sample					Recovery sample					
Date	Reach d	NF length (cm)	Sex	Adipose fin	Date	Reach	POH length (cm)	Sex		Time out (days)
25-Nov	C5	62.5	M	A	02-Dec	C3	49.2	M		7
25-Nov	C5	53.5	M	A	13-Dec	S1	57.2	M	c	18
25-Nov	C5	44.0	M	A	13-Dec	C5	35.1	M		18
29-Nov	S1	53.0	F	P	18-Dec	C1	43.7	F		19
29-Nov	S1	54.0	F	P	18-Dec	C1	43.5	F		19
29-Nov	S5	50.0	M	P	18-Dec	S4	40.0	M		19
29-Nov	S5	59.0	F	P	18-Dec	S4	50.1	F		19
29-Nov	S5	52.0	M	P	18-Dec	S4	42.6	M		19
29-Nov	S5	63.0	F	P	16-Dec	S4	51.2	F		17
29-Nov	S5	62.0	F	P	18-Dec	S4	51.8	F		19
29-Nov	S5	60.0	M	P	18-Dec	S4	48.2	M		19
06-Dec	C1	59.5	F	P	13-Dec	S1	49.2	F		7
06-Dec	C1	50.0	F	P	18-Dec	C1	41.7	F		12
20-Dec	S1	61.0	F	P	06-Jan	S1	53.7	F		17

Summary:

Females initially identified as males:	0	0.0%	Mean days out =	22.4
Males initially identified as females:	1	2.9%	Maximum days out =	42.0
			Minimum days out =	7.0

POH and NF regressions:

- Adult males: POH length = 0.71 NF length + 4.57
  NF length = 1.26 POH length - 0.09
- Adult females: POH length = 0.80 NF length + 1.13
  NF length = 1.10 POH length + 5.19

a. Incorrect sex identification during disk tag application
b. No secondary mark on recovery
c. Excluded from POH and NF regressions
d. Salmon River: S1 - below Coghlan Cr; S2 - Coghlan Cr. to 64 Ave; S3 - 64 Ave to 56 Ave S4 - 56 Ave to 248 St; S5 - 248 St to 256 St. Coghlan Creek: C1 - Salmon R. to Hwy 1 C2 - Hwy 1 to 248 St; C3 - 248 St to 64 Ave; C4 - 64 Ave to 256 St; C5 - above 256 St.

Appendix 7a. Summary of live observations and dead counts of coho salmon in the Salmon River, 1991-1992.

			Dead count											
			Adipose fin present				Adipose fin absent							
Date	Reach	Live count	Male	Female	Jack	Adult total	Male	Female	Jack	Adult total	Adult total	Disk tag and secondary mark	Secondary mark only	Disk tag only
04-Dec	S4	4	3	9	0	12	1	0	0	1	13	0	0	0
	S5	9	7	6	0	13	0	1	0	1	14	0	0	0
06-Dec	S4	4	9	4	1	13	1	2	0	3	16	1	0	0
13-Dec	S1	3	23	18	1	41	1	2	0	3	46 a	8	0	1
	S3	1	7	7	0	14	0	0	0	0	14	1	0	0
16-Dec	S4	3	9	12	2	21	3	0	0	3	24	1	0	0
	S5	-	1	4	1	5	0	0	0	0	5	0	0	0
18-Dec	S1	2	2	2	0	4	1	0	0	1	5	0	0	0
	S2	3	6	2	1	8	0	0	0	0	8	0	1	0
	S3	1	8	6	0	14	0	0	0	0	14	0	0	0
	S4	2	36	37	3	73	1	3	0	4	77	9	0	0
23-Dec	S1	-	4	5	0	9	0	0	0	0	9	0	0	0
	S2	-	2	4	0	6	1	0	0	1	7	0	0	0
	S3	1	20	11	0	31	0	0	0	0	31	1	0	0
	S4	1	1	3	0	4	0	0	0	0	4	0	0	0
27-Dec	S5	-	8	9	0	17	0	1	0	1	18	0	0	0
30-Dec	S5	2	6	3	0	9	0	0	0	0	9	0	0	0
03-Jan	S1	-	1	1	0	2	0	0	0	0	2	0	0	0
	S3	-	5	2	0	7	0	0	0	0	7	0	0	0
	S4	-	6	6	0	12	0	1	0	1	13	0	0	0
06-Jan	S1	1	7	14	0	21	1	1	0	2	23	1	0	0
	S2	-	0	0	1	0	0	0	0	0	0	0	0	0
	S4	-	6	3	1	9	0	1	0	1	10	0	0	0
	S5	1	3	0	0	3	0	0	0	0	3	0	0	0
14-Jan	S1	-	3	8	0	11	0	1	0	1	12	0	0	0
	S2	1	0	1	0	1	0	0	0	0	1	0	0	0
	S3	-	1	2	0	3	0	0	0	0	3	0	0	0
Total	S1	-	40	48	1	88	3	4	0	7	97	9	0	1
	S2	-	8	7	2	15	1	0	0	1	16	0	1	0
	S3	-	41	28	0	69	0	0	0	0	69	2	0	0
	S4	-	70	74	7	144	6	7	0	13	157	11	0	0
	S5	-	25	22	1	47	0	2	0	2	49	0	0	0
	Total	-	184	179	11	363	10	13	0	23	388	22	1	1

a. Includes 2 with unkown adipose fin status

Appendix 7b. Summary of live observations and dead counts of coho salmon in Coghlan Creek, 1991-1992.

			Dead count											
			Adipose fin present				Adipose fin absent							
Date	Reach	Live count	Male	Female	Jack	Adult total	Male	Female	Jack	Adult total	Adult total	Disk tag and secondary mark	Secondary mark only	Disk tag only
02-Dec	C3	12	11	8	3	19	4	8	0	12	31	4	0	0
	C4	13	8	5	1	13	1	4	0	5	18	8	0	0
	C5	8	5	7	0	12	5	7	0	12	24	3	0	0
04-Dec	C1	5	15	24	2	39	3	1	0	4	43	5	0	0
	C2	2	4	4	0	8	1	2	0	3	11	2	0	0
13-Dec	C1	1	10	3	0	13	1	0	0	1	14	1	0	0
	C2	1	6	6	1	12	0	1	0	1	13	0	0	0
	C3	5	1	5	0	6	0	0	0	0	6	0	0	0
	C4	-	2	5	0	7	1	0	0	1	8	2	0	0
	C5	3	4	3	0	7	3	1	0	4	11	2	0	0
16-Dec	C4	-	2	1	2	3	0	0	0	0	3	0	0	0
	C5	-	1	5	0	6	0	1	0	1	7	0	0	0
18-Dec	C1	2	16	19	0	37 a	1	1	0	2	41 b	9	0	2
	C2	1	2	1	0	3	0	0	0	0	3	0	0	0
	C3	7	2	2	0	4	0	0	0	0	4	0	0	0
23-Dec	C1	2	3	6	0	9	0	0	0	0	9	1	0	0
	C2	3	1	0	0	1	0	1	0	1	2	0	0	0
	C3	-	10	5	1	15	0	1	0	1	16	2	0	0
03-Jan	C3	-	5	1	0	6	0	1	0	1	7	0	0	0
	C4	-	0	3	0	3	0	0	0	0	3	0	0	0
	C5	-	1	2	0	3	0	0	0	0	3	1	0	0
06-Jan	C1	-	2	2	0	4	0	0	0	0	4	0	0	0
	C2	1	5	1	0	6	0	0	0	0	6	0	0	0
08-Jan	C3	-	0	1	0	1	0	0	0	0	1	0	0	0
	C4	-	4	0	0	4	0	0	0	0	4	0	0	0
14-Jan	C1	2	9	7	0	16	0	0	0	0	16	0	0	0
	C2	-	1	1	0	2	0	0	0	0	2	0	0	0
Total	C1	-	55	61	2	118	5	2	0	7	127	16	0	2
	C2	-	19	13	1	32	1	4	0	5	37	2	0	0
	C3	-	29	22	4	51	4	10	0	14	65	6	0	0
	C4	-	16	14	3	30	2	4	0	6	36	10	0	0
	C5	-	11	17	0	28	8	9	0	17	45	6	0	0
	Total	-	130	127	10	257	20	29	0	49	310	40	0	2

a. Includes 2 of unknown sex.
b. Includes 2 of unknown adipose fin status.

Appendix 8. Spawning success of female adult coho spawning ground recoveries, 1991-1992.

		Percent spawned			
		0%	50%	100%	Weighted mean
Disk tag or secondary mark	Number	0	3	26	29
	Percent	0.0%	10.3%	89.7%	94.8%
Unmarked	Number	1	0	55	56
	Percent	1.8%	0.0%	98.2%	98.2%
Total	Number	1	3	81	85
	Percent	1.2%	3.5%	95.3%	97.1%

Appendix 9. Observed and estimated coho adult escapement, by CWT code, in the Salmon River system, 1991-1992.

		CWT Code			No CWT		
	Total	02 08 34	02 08 35	02 08 36	Jack	Adult	CWT lost
Estimated AFC escapement	448 a	-	-	-	-	-	-
No. AFCs recovered	72	-	-	-	-	-	-
Observed CWT codes	66	48	17	1	-	6	-
Estimated escapement by code	-	299	106	6	-	37	-

Appendix 10. Incidence of CWT loss by carcass condition, eye status, and AFC condition in AFC coho adult carcasses in the Salmon River system, 1991-1992.

Category	Condition	Sample size	CWT absent	CWT loss (%)
Carcass condition	Fresh	8	1	12.5%
	Moderately fresh	48	5	10.4%
	Moderately rotten	15	0	0.0%
	Rotten	1	0	0.0%
Eyes a	Present	62	4	6.5%
	Absent	9	1	11.1%
Adipose fin clip	aComplete	69	5	7.2%
	Partial	2	0	0.0%
	Questionable	0	0	-

a. Condition not recorded on 1 carcass

Appendix 11. Mean length, by sex and age, of Salmon River system coho spawners, 1991-1992.

Sample	Age	Sex	Sample size	Percent	Length (cm) Mean	Standard deviation	Range
Application sample a,b,c	-	Male	205	51.0%	52.7	6.7	35.0 - 73.0
	-	Female	197	49.0%	56.3	5.4	45.0 - 68.5
		Total	402	-	54.5	6.3	35.0 - 73.0
Recovery sample d	3/2	Male	36	46.2%	43.9	6.6	33.9 - 57.8
		Female	42	53.8%	47.9	3.8	38.3 - 55.9
	Total	Male	73	46.8%	43.7	6.4	30.1 - 59.5
		Female	83	53.2%	47.2	4.3	37.6 - 56.0
		Total	156	-	45.6	5.6	30.1 - 59.5

a. Not adjusted for sex identification errors.
b. NF length.
c. Excludes 3 not measured at release.
d. POH length.

Appendix 12a. Observed and estimated recoveries of Salmon River coho salmon (CWT code 02 38 38) a.

Year	Fishery	Location		Catch by month												
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1987	Sport	Strait of Georgia	Obs:	-	-	-	-	2	7	6	5	-	-	b -	-	20
			Est:	-	-	-	-	15	26	31	30	-	-	-	-	102
		Central	Obs:	-	-	-	-	-	-	-	-	-	-	1	-	1
			Est:	-	-	-	-	-	-	-	-	-	-	4	-	4
		Freshwater	Obs:	-	-	-	-	-	-	-	-	1	1	-	-	2
			Est:	-	-	-	-	-	-	-	-	4 d	4 d	-	-	8
		West Vancouver Island	Obs:	-	-	-	-	1	-	2	-	-	-	-	-	3
			Est:	-	-	-	-	4	-	8	-	-	-	-	-	12
	Troll	South Central	Obs:	-	-	-	-	-	-	-	1	-	-	-	-	1
			Est:	-	-	-	-	-	-	-	4	-	-	-	-	4
		West Vancouver Island	Obs:	-	-	-	-	-	-	4	3	-	-	-	-	7
			Est:	-	-	-	-	-	-	22	9	-	-	-	-	31
		Strait of Georgia	Obs:	-	-	-	-	-	-	8	6	1	-	-	-	15
			Est:	-	-	-	-	-	-	49	17	2	-	-	-	68
		Puget Sound c	Obs:	-	-	-	-	-	-	1	-	-	-	-	-	1
			Est:	-	-	-	-	-	-	3	-	-	-	-	-	3
	Net	Juan de Fuca	Obs:	-	-	-	-	-	-	-	-	-	5	-	-	5
			Est:	-	-	-	-	-	-	-	-	-	11	-	-	11
		Puget Sound c	Obs:	-	-	-	-	-	-	-	2	2	1	-	-	5
			Est:	-	-	-	-	-	-	-	5	9	7	-	-	21
		Fraser River	Obs:	-	-	-	-	-	-	-	-	-	1	-	-	1
			Est:	-	-	-	-	-	-	-	-	-	1	-	-	1
	Total		Obs:	0	0	0	0	3	7	21	17	4	8	1	0	61
			Est:	0	0	0	0	19	26	113	65	15	23	4	0	265

a. Department of Fisheries and Oceans database.
b. Excludes one recovery from Fort Langley (reported under freshwater sport).
c. Pacific States Marine Fisheries Commission database.
d. Assumed a 0.25 awareness factor for freshwater sport.

Appendix 12b. Observed and estimated recoveries of Salmon River coho salmon (CWT code 02 38 39) a.

Year	Fishery	Location		Catch by month												
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1987	Sport	Strait of Georgia	Obs:	-	-	-	-	2	8	8	2	2	-	- b	-	22
			Est:	-	-	-	-	15	30	42	12	13	-	-	-	112
		Puget Sound c	Obs:	-	-	-	-	-	-	-	1	-	-	-	-	1
			Est:	-	-	-	-	-	-	-	7	-	-	-	-	7
		Freshwater	Obs:	-	-	-	-	-	-	-	-	-	-	1	-	1
			Est:	-	-	-	-	-	-	-	-	-	-	4 d	-	4
	Troll	West Vancouver Island	Obs:	-	-	-	-	-	-	5	4	-	-	-	-	9
			Est:	-	-	-	-	-	-	23	16	-	-	-	-	39
		Strait of Georgia	Obs:	-	-	-	-	-	-	9	1	3	1	-	-	14
			Est:	-	-	-	-	-	-	62	3	9	2	-	-	76
	Net	Washington/ Oregon	Obs:	-	-	-	-	-	-	-	1	-	-	-	-	1
			Est:	-	-	-	-	-	-	-	1	-	-	-	-	1
		Juan de Fuca	Obs:	-	-	-	-	-	-	-	2	-	7	-	-	9
			Est:	-	-	-	-	-	-	-	7	-	16	-	-	23
		Puget Sound c	Obs:	-	-	-	-	-	-	-	1	2	-	-	-	3
			Est:	-	-	-	-	-	-	-	2	9	-	-	-	11
	Total		Obs:	0	0	0	0	2	8	22	12	7	8	1	0	60
			Est:	0	0	0	0	15	30	127	48	31	18	4	0	273

a. Department of Fisheries and Oceans database.
b. Excludes one recovery from below Mission (reported in freshwater sport).
c. Pacific State Marine Fisheries Commission database.
d. Assumed a 0.25 awareness factor for freshwater sport.

Appendix 12c. Observed and estimated recoveries of Salmon River coho salmon (CWT code 02 38 40) a.

Year	Fishery	Location		Catch by month												Total
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1987	Sport	Strait of Georgia	Obs:	-	-	-	1	-	4	11	2	2	-	-	-	20
			Est:	-	-	-	4	-	15	57	12	13	-	-	-	101
		Puget Sound b	Obs:	-	-	-	-	-	-	-	-	1	-	-	-	1
			Est:	-	-	-	-	-	-	-	-	3	-	-	-	3
		Washington/ Oregon b	Obs:	-	-	-	-	-	-	1	-	-	-	-	-	1
			Est:	-	-	-	-	-	-	2	-	-	-	-	-	2
		Central	Obs:	-	-	-	-	-	-	-	1	-	-	-	-	1
			Est:	-	-	-	-	-	-	-	4	-	-	-	-	4
	Troll	West Vancouver Island	Obs:	-	-	-	-	-	-	9	5	-	-	-	-	14
			Est:	-	-	-	-	-	-	47	14	-	-	-	-	61
		South Central	Obs:	-	-	-	-	-	-	1	-	-	-	-	-	1
			Est:	-	-	-	-	-	-	3	-	-	-	-	-	3
		Strait of Georgia	Obs:	-	-	-	-	-	-	7	1	3	1	-	-	12
			Est:	-	-	-	-	-	-	42	2	11	2	-	-	57
	Net	Johnstone Strait	Obs:	-	-	-	-	-	-	-	-	1	-	-	-	1
			Est:	-	-	-	-	-	-	-	-	2	-	-	-	2
		Strait of Georgia	Obs:	-	-	-	-	-	-	-	1	-	-	-	-	1
			Est:	-	-	-	-	-	-	-	3	-	-	-	-	3
		Juan de Fuca	Obs:	-	-	-	-	-	-	-	2	1	5	-	-	8
			Est:	-	-	-	-	-	-	-	7	3	11	-	-	21
		Puget Sound b	Obs:	-	-	-	-	-	-	-	-	-	1	-	-	1
			Est:	-	-	-	-	-	-	-	-	-	7	-	-	7
	Total		Obs:	0	0	0	1	0	4	29	12	8	7	0	0	61
			Est:	0	0	0	4	0	15	151	42	32	20	0	0	264
1988	Troll	South Central	Obs:	-	-	-	-	-	-	1	-	-	-	-	-	1
			Est:	-	-	-	-	-	-	3	-	-	-	-	-	3
	Total		Obs:	0	0	0	0	0	0	1	0	0	0	0	0	1
			Est:	0	0	0	0	0	0	3	0	0	0	0	0	3
Total			Obs:	0	0	0	1	0	4	30	12	8	7	0	0	62
			Est:	0	0	0	4	0	15	154	42	32	20	0	0	267

a. Department of Fisheries and Oceans database.
b. Pacific States Marine Fisheries Commission database.

Appendix 12d. Observed and estimated recoveries of Salmon River coho salmon (CWT code 02 43 10) a.

Year	Fishery	Location		Catch by month												Total
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1987	Sport	Strait of Georgia	Obs:	-	-	-	-	-	-	-	-	-	- b	- b	-	0
			Est:	-	-	-	-	-	-	-	-	-	-	-	-	0
		Freshwater	Obs:	-	-	-	-	-	-	-	-	-	1	1	-	2
			Est:	-	-	-	-	-	-	-	-	-	4 d	4 d	-	8
	Net	Puget Sound c	Obs:	-	-	-	-	-	-	-	-	-	1	-	-	1
			Est:	-	-	-	-	-	-	-	-	-	2	-	-	2
	Total		Obs:	0	0	0	0	0	0	0	0	0	2	1	0	3
			Est:	0	0	0	0	0	0	0	0	0	6	4	0	10
1988	Sport	Strait of Georgia	Obs:	-	-	-	15	47	82	57	28	2	3 e	0 e	1	235
			Est:	-	-	-	88	312	425	480	281	16	13	0	3	1,618
		Central	Obs:	-	-	-	-	-	-	1	2	1	-	-	-	4
			Est:	-	-	-	-	-	-	4	8	4	-	-	-	16
		Puget Sound c	Obs:	-	-	-	-	1	1	5	1	-	2	-	-	10
			Est:	-	-	-	-	6	3	17	7	-	13	-	-	46
		Washington/ Oregon c	Obs:	-	-	-	-	-	-	1	-	-	-	-	-	1
			Est:	-	-	-	-	-	-	3	-	-	-	-	-	3
		Freshwater	Obs:	-	-	-	-	-	-	-	-	-	3 c	4 f	-	7
			Est:	-	-	-	-	-	-	-	-	-	12 d	16 d	-	28
	Troll	South Central	Obs:	-	-	-	-	-	-	2	6	2	-	-	-	10
			Est:	-	-	-	-	-	-	6	18	9	-	-	-	33
		West Vancouver Island	Obs:	-	-	-	-	-	-	32	33	15	-	-	-	80
			Est:	-	-	-	-	-	-	144	144	68	-	-	-	356
		Strait of Georgia	Obs:	-	-	-	-	-	-	116	37	27	-	-	-	180
			Est:	-	-	-	-	-	-	421	166	63	-	-	-	650
		Washington/ Oregon c	Obs:	-	-	-	-	-	-	-	2	-	-	-	-	2
			Est:	-	-	-	-	-	-	-	10	-	-	-	-	10

Continued

Appendix 12d continued. Observed and estimated recoveries of Salmon River coho salmon (CWT code 02 43 10). a

Year	Fishery	Location		Catch by month Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
	Net	Central	Obs:	-	-	-	-	-	-	1	-	-	-	-	-	1
			Est:	-	-	-	-	-	-	2	-	-	-	-	-	2
		Johnstone Strait	Obs:	-	-	-	-	-	-	-	6	5	13	-	-	24
			Est:	-	-	-	-	-	-	-	23	13	24	-	-	60
		Strait of Georgia	Obs:	-	-	-	-	-	-	-	-	-	2	-	-	2
			Est:	-	-	-	-	-	-	-	-	-	5	-	-	5
		Juan de Fuca	Obs:	-	-	-	-	-	-	-	11	-	-	-	-	11
			Est:	-	-	-	-	-	-	-	32	-	-	-	-	32
		West Vancouver Island	Obs:	-	-	-	-	-	-	-	-	-	4	-	-	4
			Est:	-	-	-	-	-	-	-	-	-	5	-	-	5
		Puget Sound c	Obs:	-	-	-	-	-	-	3	1	1	28	1	-	34
			Est:	-	-	-	-	-	-	13	4	2	121	6	-	146
		Fraser River	Obs:	-	-	-	-	-	-	-	-	3	42	-	-	45
			Est:	-	-	-	-	-	-	-	-	8	105	-	-	113
	Total		Obs:	0	0	0	15	48	83	218	127	56	97	5	1	650
			Est:	0	0	0	88	318	428	1,090	693	183	298	22	3	3,123
Total			Obs:	0	0	0	15	48	83	218	127	56	99	6	1	653
			Est:	0	0	0	88	318	428	1,090	693	183	304	26	3	3,133

a. Department of Fisheries and Oceans database.
b. Excludes one recovery from Fraser River (reported in freshwater sport).
c. Pacific States Marine Fisheries Commission database.
d. Assumed a 0.25 awareness factor for freshwater sport.
e. Excludes threee recoveries from Fraser River (reported in freshwater sport).
f. Includes 3 recoveries from Pacific States Marine Fisheries Commision database.

Appendix 12e. Observed and estimated recoveries of Salmon River coho salmon (CWT code 02 49 38) a.

Year	Fishery	Location		Catch by month												Total
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1988	Net	Puget Sound b	Obs:	-	-	-	-	-	-	-	-	-	1	-	-	1
			Est:	-	-	-	-	-	-	-	-	-	4	-	-	4
	Total		Obs:	0	0	0	0	0	0	0	0	0	1	0	0	1
			Est:	0	0	0	0	0	0	0	0	0	4	0	0	4
1989	Sport	Strait of Georgia	Obs:	-	-	-	5	11	45	44	22	10	2	4	-	143
			Est:	-	-	-	44	103	139	262	123	83	11	5	-	770
		Puget Sound b	Obs:	-	-	-	-	-	1	1	5	6	1	-	-	14
			Est:	-	-	-	-	-	7	7	18	18	5	-	-	55
		Washington/ Oregon b	Obs:	-	-	-	-	-	-	2	3	2	-	-	-	7
			Est:	-	-	-	-	-	-	7	6	2	-	-	-	15
	Troll	West Vancouver Island	Obs:	-	-	-	-	-	-	91	17	-	-	-	-	108
			Est:	-	-	-	-	-	-	524	127	-	-	-	-	651
		Strait of Georgia	Obs:	-	-	-	-	-	-	18	-	7	-	-	-	25
			Est:	-	-	-	-	-	-	80	-	20	-	-	-	100
		Washington/ Oregon b	Obs:	-	-	-	-	-	-	-	9	-	-	-	-	9
			Est:	-	-	-	-	-	-	-	23	-	-	-	-	23
	Net	Strait of Georgia	Obs:	-	-	-	-	-	-	-	-	-	2	1	-	3
			Est:	-	-	-	-	-	-	-	-	-	6	1	-	7
		Johnstone Strait	Obs:	-	-	-	-	-	-	-	3	7	-	-	-	10
			Est:	-	-	-	-	-	-	-	11	21	-	-	-	32
		Juan de Fuca	Obs:	-	-	-	-	-	-	16	19	23	-	-	-	58
			Est:	-	-	-	-	-	-	62	108	92	-	-	-	262
		West Vancouver Island	Obs:	-	-	-	-	-	-	-	-	-	9	-	-	9
			Est:	-	-	-	-	-	-	-	-	-	36	-	-	36
		Puget Sound b	Obs:	-	-	-	-	-	-	1	4	19	-	-	-	24
			Est:	-	-	-	-	-	-	4	7	94	-	-	-	105
		Fraser River	Obs:	-	-	-	-	-	-	-	-	1	1	-	-	2
			Est:	-	-	-	-	-	-	-	-	3	2	-	-	5
	Total		Obs:	0	0	0	5	11	46	173	82	75	15	5	0	412
			Est:	0	0	0	44	103	146	946	423	333	60	6	0	2,061
Total			Obs:	0	0	0	5	11	46	173	82	75	16	5	0	413
			Est:	0	0	0	44	103	146	946	423	333	64	6	0	2,065

a. Department of Fisheries and Oceans database.
b. Pacific States Marine Fisheries Commision database.

Appendix 12f. Observed and estimated recoveries of Salmon River coho salmon (CWT code 02 57 25) a.

Year	Fishery	Location		Catch by month												
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1989	Sport	Freshwater	Obs:	-	-	-	-	-	-	-	-	-	2	-	-	2
			Est:	-	-	-	-	-	-	-	-	-	4 b	-	-	4
	Total		Obs:	0	0	0	0	0	0	0	0	0	2	0	0	2
			Est:	0	0	0	0	0	0	0	0	0	4	0	0	4
1990	Sport	Strait of Georgia	Obs:	-	-	-	1	11	47	10	9	4	-	-	-	82
			Est:	-	-	-	4	43	152	65	52	23	-	-	-	339
		Washington/ Oregon c	Obs:	-	-	-	-	-	-	2	-	-	-	-	-	2
			Est:	-	-	-	-	-	-	5	-	-	-	-	-	5
	Troll	Central	Obs:	-	-	-	-	-	2	8	-	-	-	-	-	10
			Est:	-	-	-	-	-	5	19	-	-	-	-	-	24
		Northern	Obs:	-	-	-	-	-	1	-	-	-	-	-	-	1
			Est:	-	-	-	-	-	6	-	-	-	-	-	-	6
		West Vancouver Island	Obs:	-	-	-	-	-	2	24	6	6	-	-	-	38
			Est:	-	-	-	-	-	10	111	54	42	-	-	-	217
		Strait of Georgia	Obs:	-	-	-	-	-	1	50	9	8	-	-	-	68
			Est:	-	-	-	-	-	4	150	27	59	-	-	-	240
		Washington/ Oregon c	Obs:	-	-	-	-	-	-	-	1	-	-	-	-	1
			Est:	-	-	-	-	-	-	-	2	-	-	-	-	2
	Net	Central	Obs:	-	-	-	-	-	-	1	-	-	-	-	-	1
			Est:	-	-	-	-	-	-	2	-	-	-	-	-	2
		Johnstone Strait	Obs:	-	-	-	-	-	-	-	-	6	-	-	-	6
			Est:	-	-	-	-	-	-	-	-	19	-	-	-	19
		Juan de Fuca	Obs:	-	-	-	-	-	-	-	3	-	-	-	-	3
			Est:	-	-	-	-	-	-	-	9	-	-	-	-	9
		Puget Sound c	Obs:	-	-	-	-	-	-	1	-	1	5	-	-	7
			Est:	-	-	-	-	-	-	2	-	6	43	-	-	51
		Fraser River	Obs:	-	-	-	-	-	-	-	-	-	5	4	-	9
			Est:	-	-	-	-	-	-	-	-	-	13	8	-	21
	Total		Obs:	0	0	0	1	11	53	98	28	25	10	4	0	228
			Est:	0	0	0	4	43	177	354	144	149	56	8	0	935

Continued

Appendix 12f continued. Observed and estimated recoveries of Salmon River coho salmon (CWT code 02 57 25). a

Year	Fishery	Location		Catch by month												
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1991	Sport	Strait of Georgia	Obs:	-	-	-	-	-	-	-	-	-	1	-	-	1
			Est:	-	-	-	-	-	-	-	-	-	4	-	-	4
	Total		Obs:	0	0	0	0	0	0	0	0	0	1	0	0	1
			Est:	0	0	0	0	0	0	0	0	0	4	0	0	4
Total			Obs:	0	0	0	1	11	53	96	28	25	13	4	0	231
			Est:	0	0	0	4	43	177	354	144	149	60	8	0	939

a. Department of Fisheries and Oceans database.
b. Assumed a 0.25 awareness factor for freshwater sport.
c. Pacific States Marine Fisheries Commission database.
d. Used expansion factor of 1.0
e. Used expansion factor of 0.25

Appendix 12g. Observed and estimated recoveries of Salmon River coho salmon (CWT code 02 63 22) a.

Year	Fishery	Location		Catch by month												
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1990	Sport	Strait of Georgia	Obs:	-	-	-	3	34	67	26	12	9	2	-	-	153
			Est:	-	-	-	13	133	217	169	70	51	6	-	-	659
		Central	Obs:	-	-	-	-	-	-	1	-	-	-	-	-	1
			Est:	-	-	-	-	-	-	4	-	-	-	-	-	4
		Washington/ Oregon b	Obs:	-	-	-	-	-	-	-	1	1	-	-	-	2
			Est:	-	-	-	-	-	-	-	5	3	-	-	-	8
	Troll	Central	Obs:	-	-	-	-	-	-	4	1	-	-	-	-	5
			Est:	-	-	-	-	-	-	11	2	-	-	-	-	13
		Washington/ Oregon b	Obs:	-	-	-	-	-	-	-	4	-	-	-	-	4
			Est:	-	-	-	-	-	-	-	13	-	-	-	-	13
		Puget Sound b	Obs:	-	-	-	-	-	-	-	1	-	-	-	-	1
			Est:	-	-	-	-	-	-	-	9	-	-	-	-	9
		West Vancouver Island	Obs:	-	-	-	-	-	1	54	19	5	-	-	-	79
			Est:	-	-	-	-	-	5	260	151	38	-	-	-	454
		Strait of Georgia	Obs:	-	-	-	-	-	2	80	13	10	-	-	-	105
			Est:	-	-	-	-	-	9	241	40	29	-	-	-	319
	Net	Strait of Georgia	Obs:	-	-	-	-	-	-	-	-	-	1	-	-	1
			Est:	-	-	-	-	-	-	-	-	-	3	-	-	3
		Johnstone Strait	Obs:	-	-	-	-	-	-	-	2	-	3	-	-	5
			Est:	-	-	-	-	-	-	-	8	-	11	-	-	19
		Juan de Fuca	Obs:	-	-	-	-	-	-	-	6	-	-	-	-	6
			Est:	-	-	-	-	-	-	-	31	-	-	-	-	31
		Puget Sound b	Obs:	-	-	-	-	-	-	1	-	-	9	-	-	10
			Est:	-	-	-	-	-	-	2	-	-	61	-	-	63
		Fraser River	Obs:	-	-	-	-	-	-	-	1	-	20	9	-	30
			Est:	-	-	-	-	-	-	-	5	-	50	17	-	72
	Total		Obs:	0	0	0	3	34	70	166	60	25	35	9	0	402
			Est:	0	0	0	13	133	231	687	334	121	131	17	0	1,667

Continued

Appendix 12g continued. Observed and estimated recoveries of Salmon River coho salmon (CWT code 02 63 22). a

Year	Fishery	Location		Catch by month												
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1991	Troll	West Vancouver Island	Obs:	-	-	-	-	-	-	1	-	-	-	-	-	1
			Est:	-	-	-	-	-	-	3	-	-	-	-	-	3
	Total		Obs:	0	0	0	0	0	0	1	0	0	0	0	0	1
			Est:	0	0	0	0	0	0	3	0	0	0	0	0	3
Total			Obs:	0	0	0	3	34	70	167	60	25	35	9	0	403
			Est:	0	0	0	13	133	231	690	334	121	131	17	0	1,670

a. Department of Fisheries and Oceans database.
b. Pacific States Marine Fisheries Commission database.